Review WES 2025-194

November 25, 2025

Introduction

The paper by Firpo et al. investigates the wake of a floating turbine with imposed fore-aft motion (surge and pitch), using results from CFD simulation with two different methods (URANS and LES). The numerical data are compared with wind tunnel experiments from the Nettunto campaign. Overall, the paper is well written, the analysis is convincing, and the results are of interest to the community. So in principle suitable for a publication in WES journal. Please see my comments below.

Key strengths of the article include:

- **Comparison of laminar and turbulent backgrounds**: The analysis of wake recovery and dynamics for both fixed and fore-aft motion cases is convincing and aligns well with previous studies (e.g., Li et al. 2022, Messmer et al. 2024). Beyond this agreement, the paper's novel contributions—particularly the comparison of numerical methods and the insights into wake meandering—add value to the field.
- **Validation of LES against experimental data**: The comparison between simulation results and wind tunnel experiments is valuable.
- **Practical implications for downstream turbines**: The discussion on the potential impact on downstream turbines is of interest.

Points for improvement:

- **Limited scope of motion cases**: The study focuses on a single motion case—one frequency and amplitude of motion. While this choice is understandable for the purpose of comparing numerical methods (LES and URANS) with experimental data, it limits the generality of the conclusions regarding systematic differences between laminar and turbulent inflow conditions and their effects on wake recovery and dynamics.

Suggestion: The authors should explicitly acknowledge this limitation and justify the selection of this specific case. Additionally, they could frame the paper more clearly as a methodological comparison rather than a comprehensive analysis of motion effects.

Additional cases: To strengthen the findings, it would be valuable to include additional cases with larger amplitudes or varying frequencies, as turbulent inflow effects might differ significantly under these conditions.

- **Length and focus of the analysis**: The paper contains extensive analysis and numerous plots, which, may distract from the core contributions. The primary focus could be highlighted more effectively by streamlining the presentation.

Additional comments:

1. **Title Clarity**: As also noted by Referee 1, the current title is misleading. I recommend revisiting and refining it to better reflect the paper's focus and content, i.e remove the second part on impact on a downstream turbine and change 'multi-fidelity'.

2. **Literature Review**: The literature review could be expanded to include additional relevant studies, which you may have a look at, such as
   Li, Yu, Sarlak in *Wind Energy* (2024)
   Hubert, Conan, Aubrun in *Wind Energy Science* (2024)
   Messmer, Peinke, Croce, Holling in *Journal of Fluid Mechanic*s (2025)
   Liu, Zhong, Zhao, Wan in *Physics of Fluids* (2025)
   Mian, Messmer, Stoevesandt, Siddiqui in *Energy* (2025)

   which may provide further context or support for your results and analysis.

3. **Figure 4**: The plot shows a noticeable mean offset. Could the authors provide an explanation for this discrepancy? How precisely is the reference velocity U_0 determined in the experiments? While the dynamics appear well-captured, the offset remains unclear—why?

4. **Figure 10**: Please add the experimental point if you have (the figures 9 and 10 could be compiled)

5. **Figure 11**: Please clarify what constitutes "a sufficient number of platform motion cycles" for ensuring a stable trend estimate. Additionally, linking the platform motion signal with the phase of coherent fluctuations could provide deeper insight.

6. **Figure 12**: Please specify the unit used in this figure.

7. **Figure 12b (LES)**: The observation that the magnitude of pitch-related coherent fluctuations increases after 4D—despite decaying between 2D and 4D—is unexpected. What is happening there?

8. **Figure 14**: Please comment on the large differences between LES and URANS, especially knowing that in Mian, et al. *Energy* (2025), URANS was used to reconstruct flow structures, from my understanding, in a satisfying way. Here, it looks like the URANS is unable to reproduce the dynamics. Please add experimental points if available.

9. **Figures 15 and 16**: These could be merged into a single figure.

10. **Figure 17**: These results are of interest, particularly in Figure 17b. It is nice to see the difference between laminar and turbulent inflow in terms of wake meandering for surge. Focusing on the surge case (LES, turbulent inflow) around 2D, it looks like surge motion influences near-wake dynamics differently than fixed, and that the wake motions are a coupling between meandering and a mild plusating pattern. This could further be investigated and would add value to the paper. For instance, one can extend the analysis of figure 18 at different wake regions, for $x \in [1, 5]D$.

11. **Figure 18**: The meandering motion observed in the wake raises questions about the mechanisms triggering it. You could examine the free-stream power spectrum to see if the region around $f = 0.8$ Hz contains significant energy in the inflow, potentially linking free-stream structures to the wake dynamics.

12. **Figures 19 and 20**: The analysis on wake centre dynamics effectively demonstrates that surge and pitch motions do not significantly increase meandering with the turbulent inflow, nice result. These figures could be merged for conciseness.

13. **Figure 21 (URANS)**: The wake dynamics seem to retain some structural features of the motion, even though the inflow is turbulent, particularly the alternating blue and red regions of U_y, which suggest wake pulsating. Could the authors discuss this further, especially in relation to my previous comment 10.

14. **Downstream turbine**: The differences between LES and URANS on the loads should be linked to the results of the flow structures found in the wake, depending on the numerical method used.

Good luck with the revision,